

DESCRIPTION OF A NEW AUSTRALIAN MITE (ACARINA: TROMBIDIOIDEA), WITH COMMENTS ON SUPERFAMILY CLASSIFICATION

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A new larval mite, *Yurebilla gracilis* gen. et. sp. nov., is described from the Mount Lofty Ranges, South Australia, from among soil and leaf litter, free-living. A new family, Yurebillidae fam. nov. is proposed for it. The classification of the superfamily Trombidioidea and related groups is discussed.

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The superfamily Trombidioidea is a large, cosmopolitan, diverse group of Acarina. Various attempts to classify its members into family, and higher and lower, groupings have been made over many years, since the pioneer studies of Berlese (1910, 1912). All students of the Trombidioidea (and other Parasitengona) have had to face the fact that extreme heteromorphy exists between the larval and postlarval instars, so that in many cases, following the small numbers of correlations that have been achieved between the larvae and the postlarvals, a dual generic and specific nomenclature has evolved (see e.g. Southcott 1994). Subsequently, revision of the classification of the Trombidioidea were made by Oudemans (1923), Thor (1935a, b), Thor & Willmann (1947), Feider (1959, 1979), Vercammen-Grandjean (1973), Robaux (1974), Southcott (1982, 1987a,b) and Welbourn (1984, 1991). Welbourn (1984) estimated that the Trombidioidea contained 'some 225 genera, and more than 3000 species', and contained 'an unsettled number of families'.

He divided the superfamily into eight tribes, using a total of 41 larval characters, largely based on chaetotaxy; characters of the adults were not used. In his second cladistic revision (1991) he followed Feider in elevating the previous group Trombidioidea to a 'subcohort Trombidiina' (Feider had used the term 'phalanx'), which he divided into four superfamilies, using a total of 19 larval characters and six adult characters.

In the present paper is described a new trombidoid larva, obtained by systematic Berlese funnel extractions of samples of soil and litter from the Mount Lofty Ranges, South Australia.

As the characters of this larva do not fit into any of the existing classifications of the Trombidioidea including the most recent ones of Welbourn (1984, 1991), a new family, genus and species is proposed. The classification of the Trombidioidea will be discussed.

MATERIALS AND METHODS

The mites were collected as larvae by systemic Berlese funnel extractions from soil and litter samples taken in the Mount Lofty Ranges, South Australia. All were collected free-living; none was attached to an arthropod host. Initial extracts were made into 70% ethanol, later specimens were collected live in the hope of making significant biological observations.

Students of the higher classification of the Trombidioidea have used the suprageneric terms with various expanded or restricted definitions, with varying status. Thus one finds the term referring to the trombiculid mites used as Trombiculini, Trombiculinae, Trombiculidae and Trombiculoidea, with varying content, similarly with Chyzeriini, Chyzeriinae, Chyzeriidae and Chyzerioidea, and the same applies with other trombidoids. In order to save redefining each term as it is discussed, as far as possible family terms will be used, with -idae endings, without a formal commitment to the ultimate status of the taxon.

All drawings were made using an Ortholux/Laborlux microscope, with a drawing apparatus. All measurements are in micrometres (μm) unless otherwise stated.

Setal and other coding follows Southcott (1992,

1993, 1994). The holotype and paratypes are deposited in the South Australian Museum (SAM).

SYSTEMATICS

YUREBILLIDAE new family

Diagnosis of larva

Trombidioidea. Eyes two on each side, sessile. Prodorsal scutum with anterior nasus, six non-sensillary setae and two sensillary setae. Scutellum absent. Palpal and pedal supracoxalae absent. Gnathosoma without chitinous mouth-ring. Coxalae I & II contiguous, with urstigma on posterior part of coxa I. Coxal setal formula 2, 1, 1: medial coxala I and coxalae II & III nude. Leg segmental formula 6, 6, 6. Leg tarsi with 3, 3, 2 claws (i.e. posterior claw of tarsus III absent). Leg tarsi without ventral sensillae (eupathididae). Palpal femur and genu without setae.

Postlarval stages not known.

Type genus *Yurebilla* gen. nov.

Remarks

Yurebillidae resembles the family Allothrombiidae, but differs by having a nude medial coxala I and in lacking a scutellum, and in having a coxal setal pattern of 2, 1, 1 instead of 2, 2, 1.

The family at present contains only the genus with its type species *Y. gracilis* sp. nov.

Yurebilla gen. nov.

Diagnosis of larva

With the characters of Yurebillidae, and : odontus (palpal tibial claw) bifid. Trochanteralae 1, 1, 1. Femoralae 5, 4, 4. Genuae 6 (4Sc + 1So + 1Vs), 5 (3Sc + 1So + 1Vs), 4 (3Sc + 1So).

Type species *Yurebilla gracilis* sp. nov.

Etymology

The term *Yurebilla* is derived from the aboriginal (Kaurna) name for Mount Lofty, South Australia (Ellis 1976).

Yurebilla gracilis sp. nov.

(Figs 1A–C, 2A–C)

Material examined

Holotype: South Australia, Mount Lofty

(summit), in soil and leaf litter in *Eucalyptus obliqua* forest, (sample TX272), 4.i.1988, R. V. Southcott, extracted by Berlese funnel 9.i.1988, larva (SAM ACA985).

Paratypes: South Australia. Mount Lofty summit, site as for holotype, sample TX280, 5.iv.1988, larva ACB1019, RVS, extracted by Berlese funnel 12.iv.1988. Same site, sample TX297, 18.i.1990, five larvae ACB1121, 1122A–D, RVS, extracted 20.i.1990; one larva ACA1123, extracted 21.i.1990, RVS. Waitpinga Beach, southern Mount Lofty Ranges, 17.xi.1953, RVS, sample TX60, one larva ACB606, extracted into ethanol. All in SAM.

Description of larva

The following description is based on the slide-mounted holotype, supplemented by paratypes. Metric data for the holotype and paratypes are given in Table 1.

Colour in life orange. Idiosoma 625 long, 295 wide; total length to tip of chelicerae 655 (the same idiosomal and total measurements before mounting were 584, 249, 627 respectively). Dorsal scutum oblong, with undulate borders; anterior end produced into a blunt-pointed nasus; scutum weakly chitinized, without special markings. Scutalae pointed, nude; AM setae near root of nasus; AL setae small, arising slightly anterolateral to sensillary setae bases; PL setae arise near posterolateral angles of scutum. Sensillary setae slender, tapering, with fine setules in distal half. Dorsal scutum with a central longitudinal rod (crista), 30 long, from behind level of AM setae to about 6 posterior to level of sensillary setae bases. Eyes: each lateral eye pair lateral to posterior half of scutum; eyes circular, anterior 9 across, posterior 6 across.

Dorsum of idiosoma with 20 setae, arranged 2, 4, 6, 2, 4, 2; first pair about one-quarter back from anterior end of dorsum (hence no 'ocular' setae are present). Setae slender, mostly almost spiniform (a few faint setules present); the most posterior pair with a few adnate, slight setules as is the case with the most posterior ventral pair. All idiosomal setae arise from a small basal plate.

Ventral surface of idiosoma with a pair of almost spiniform setae, 18 long, arising well behind coxae II. Behind coxae III are three pairs of similar setae, 18–24 long, followed by the posterior pair, 40 long. Lateral coxala I at the anterolateral angle of the coxa, with three or four setules; medial coxala I and coxalae II and III slender, spiniform. Anus apparently imperforate.

Legs: lengths I 240, II 185, III 210 (including

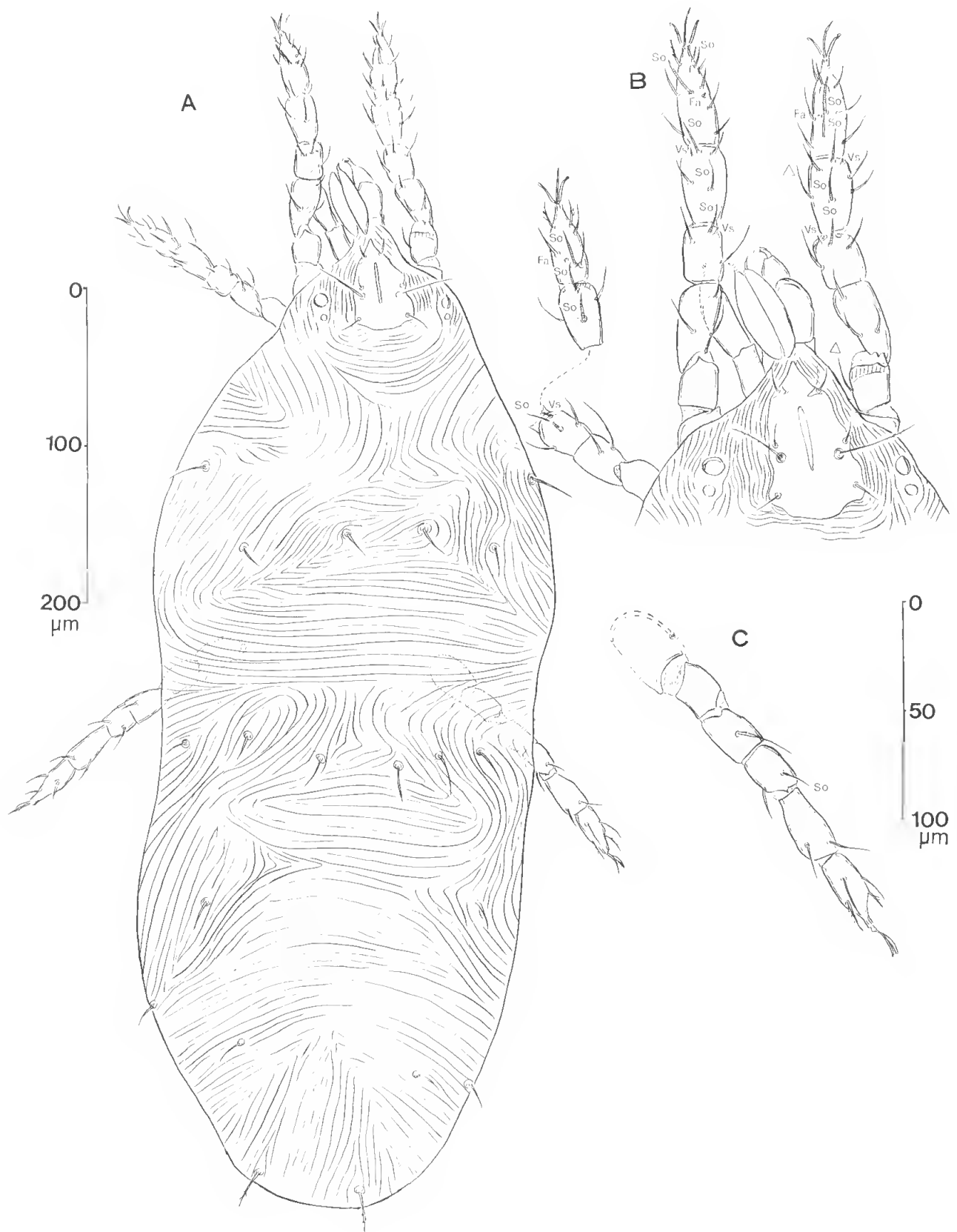


FIGURE 1. *Yurebilla gracilis*, gen. et sp. nov., larva, holotype. A, Dorsal view, entire. B, Propodosoma and adjacent structures, dorsal view. C, Leg III, dorsal view. (Figures to standard symbols; each to nearer scale.)

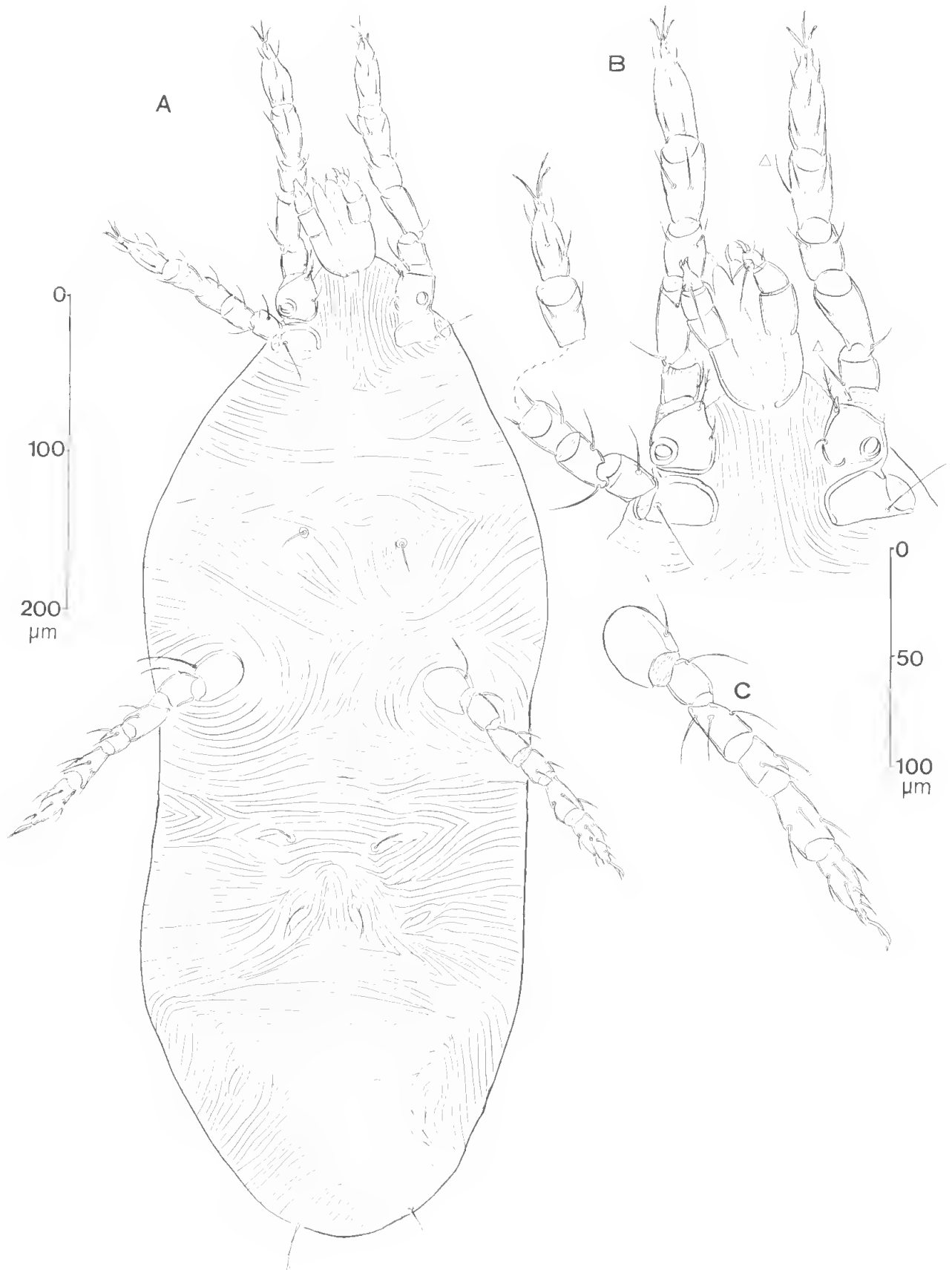


FIGURE 2. *Yurebilla gracilis*, gen. et sp. nov., larva, holotype. A, Ventral view, entire. B, Propodosoma and adjacent structures, ventral view; symbols standard. C, Leg III, ventral view. (Each to nearer scale.)

TABLE 1. Metric data for *Yurebilla gracilis* gen. et. sp. nov., larva

Character	Holotype	n	range	mean	s.d.	c.v.
LN	c. 15	9	10-23	17.7	3.97	22.5
MA	32	9	27-32	30.4	1.51	5.0
AW	29	9	29-37	33.7	2.45	7.3
PW	32	9	32-38	34.9	2.26	6.5
SB	22	9	22-30	26.3	2.24	8.5
MSA	29	9	25-31	28.7	1.73	6.0
ASB	54	9	43-58	52.6	4.30	8.2
PSB	32	9	29-36	32.8	2.39	7.3
L	86	9	77-92	85.2	5.02	5.9
W	40	9	40-57	49.7	5.20	10.5
AP	23	9	20-27	23.7	2.45	10.3
SA	7	9	7-9	7.44	0.726	9.8
SP	18	9	16-21	18.7	1.50	8.0
AM	19	9	13-20	17.9	2.32	12.9
AL	13	9	10-15	12.6	1.33	10.6
PL	18	9	18-23	21.6	1.42	6.6
AMB	19	9	18-23	19.6	1.59	8.1
SE	53	9	49-59	54.2	2.68	4.9
DS	24-33	9	33-40*	36.2*	2.05*	5.7*
MDS	22	9	22-25*	22.9*	0.928*	4.1*
PDS	33	9	33-40*	36.2*	2.05*	5.7*
Fel	37	9	33-46	41.2	4.52	11.0
Gel	28	9	22-29	25.6	2.35	9.2
Til	38	9	35-43	37.3	2.65	7.1
Tal(L)	41	9	38-45	42.3	2.00	4.7
Tal(H)	22	9	17-23	19.6	2.01	10.3
Til/Gel	1.36	9	1.28-1.64	1.46	0.104	7.1
FelI	27	8	27-34	31.1	2.23	7.2
GelI	19	9	18-22	20.8	1.48	7.1
TilI	23	9	23-33	28.4	3.32	11.7
TalI(L)	42	9	29-42	36.6	3.97	10.9
TalI(I)	16	9	16-19	16.4	1.01	6.2
TilI/GelI	1.21	9	1.19-1.61	1.36	0.140	10.3
FelII	38	9	33-40	36.3	2.65	7.3
GelII	22	9	19-24	21.8	1.79	8.2
TilII	39	9	28-40	35.1	3.66	10.4
TalII(L)	33	9	33-40	36.2	2.49	6.9
TalII(H)	18	9	14-18	16.1	1.36	8.5
TilII/GelII	1.77	9	1.40-1.80	1.62	0.137	8.5
SA/SP	0.39	9	0.35-0.45	0.400	0.0350	8.8
AW/AMB	1.53	9	1.53-1.89	1.72	0.144	8.4

* For maximum values

coxae and claws). Leg scobalae slender, spiniform.

Leg specialised setae: SoGeI.76d(17), VsGeI.76ad(5), SoTiI.39d(19), SoTiI.88d(16), VsTiI.87pd(4), SoGeII.62d(14), VsGeII.90d(3), SoTiII.36d(11), SoTiII.92d(10), SoGeIII.53d(12).

Tarsus I with FaTaI.53ad(minute), SoTaI.55d(13), SoTaI.85d(13) (arising from a distinct boss). Tarsus II with SoTaII.38ad(15), FaTaII.40pd(2).

Tarsal claws: on tarsus I & II the laterals (a & p) falciform, smooth, equal, empodium (m)

slender, curved, over-reaching laterals. On tarsus III anterior claw similar to laterals of I & II, but larger; empodium as for I & II, but longer, over-reaching anterior claw; posterior claw absent.

Gnathosoma: chelicerae bases slender, 42 long by 26 across (combined); digits curved, pointed, simple, about 7 long. Galeala (protorostral seta) slender, spiniform, c. 5 long. No deutorostral or tritorostral setae identified, nor basis capituli setae. Palpi slender, femur and genu without setae, palpal tibia with three slender, spiniform setae.

Palpal tarsus a blunt cone, 6 long, by 4 wide at

base; on it three simple slender setae can be identified under oil immersion, longest seta 20 long. Palpal tibial claw (odontus) bifid, the tines curved, lightly separated, blunted, the medial tine the larger.

Etymology

The word *gracilis* is from Latin, for slender.

REMARKS ON THE CLASSIFICATION OF YUREBILLIDAE AND YUREBILLA

The presence of an urstigma (Claparède's organ) in larval *Yurebilla*, and its general facies, clearly defines *Yurebilla* as a member of the Trombidioidea, using this term in a customary sense. The only other larva of the Trombidiformes with an urstigma is *Calyptostoma* (Calyptostomatidae). A variety of other characters has been responsible of the separation of Calyptostomatidae from the Trombidioidea; among those of the larva the presence of multisetose coxae is one of the most notable (see e.g. Shiba 1976). Welbourn (1991) in fact, on the basis of cladistic analysis, groups the Erythraeoidea and the Calyptostomatoidea in a subcohort Erythraeina of the Parasitengona.

None of the characters used above in defining Yurebillidae is unique among the families of the Trombidioidea, all of which are terrestrial. (We may exclude from further discussion the Hydracarina (Hydrachnoidea of Krantz (1978)), on grounds of general morphology, although they clearly derive from a common ancestry with the Trombidioidea.)

Considering the defining characters given above systematically, the first character given is of two eyes on each side. This character is virtually present throughout the Trombidioidea. Two genera in which eyes are absent are *Beronium* Southcott, 1986b, erected for larva parasitic on a cavernicolous beetle, and *Audyana* Womersley, 1954a, a larva which was collected ectoparasitic on a Malayan scorpion, *Heterometrus longimanus* (Herbst), probably largely nocturnal (see e.g. Harrison 1954). The deutonymph of *Audyana thompsoni* Womersley also lacks eyes (Womersley 1954b). This genus was placed in a family Audyanidae by Southcott (1987a).

A prodorsal scutum is present throughout the Trombidioidea, but only a few genera possess a nasus, in disparate groupings, e.g. *Neotrombidium* (family Neotrombidiidae) (Southcott 1954; Lindquist & Vercammen-Grandjean 1971),

Leeuwenhoekinae, family Trombiculidae (many authors). Most trombidoid prodorsal scuta have two sensillary and six non-sensillary setae; exceptions are in the Trombiculidae (e.g. 4 + 2 in Trombiculinae, 5 + 2 in Leeuwenhoekinae).

A scutellum (second dorsal scutum) is present in various families of the Trombidioidea, e.g. Trombidiidae and Allothrombiidae, and Microtrombidiidae (including Microtrombidiinae and Eutrombidiinae); *Hexathrombium* in the Eutrombidiinae is unusual in having several dorsal scuta. A scutellum is absent in the Trombiculidae, Chyzeriidae (Southcott 1982) and Trombellidae (Southcott 1986a).

Palpal and pedal supracoxalae appear to be unique to the Chyzeriidae among the larvae of the Trombidioidea, but are present in some larval Erythraeoidea, e.g. *Leptus* (see e.g. Southcott 1992).

A mouth-ring, among the Microtrombidiidae, is found in most, but not all, larvae (see e.g. Southcott 1994). The presence of an equivalent structure, i.e. an expanded lip to the mouth, with a number of fine adhesive units or pads, is seen in the larval Erythraeoidea.

The coxa I & II of each side are contiguous in almost all Trombidioidea, with the urstigma closely associated with coxa I. In the Chyzeriidae coxa I & II of each side are separated (Southcott 1982).

The coxal setal formula of 2, 1, 1 is found in a number of families of the Trombidioidea, e.g. Podothrombiidae, Trombellidae, Chyzeriidae, Neotrombidiidae, and most Microtrombidiidae (*Keramotrombium*, with 2, 2, 1, is an exception), including the Eutrombidiinae. The coxal setal pattern of 2, 2, 1 occurs in the Trombidiidae and the Allothrombiidae. A nude medial coxala I occurs in *Trombidium* (Trombidiidae), Eutrombidiinae of the Microtrombidiidae, and Neotrombidiidae; a setulose medial coxala I is present in larval Allothrombiidae, Podothrombiidae, subfamily Microtrombidiinae of the Microtrombidiidae, Trombellidae and Wondecliinae. (However, Southcott 1994 recorded the larva of *Microtrombidium nitidum* Southcott as having a nude medial coxala I.)

A leg segmental pattern of 6, 6, 6 is generally present in the trombidoid larvae; Chyzeriidae and Trombiculinae have the exceptional pattern of 7, 7, 7 (i.e. divided femora); in Neotrombidiidae, as well as in the Audyanidae, the pattern is 7, 6, 6 (Womersley 1954a). A reduction of the tarsal claws is common in the Trombidioidea, e.g. with many Microtrombidiidae, and ranging through to

a single pedotarsal claw in larval Neotrombidiidae and Audyanidae. Among the larval Trombidoidea only the family Podothrombiidae has ventral sensory setae (eupathidia, eupathidale) to the tarsi (Robaux 1977; Zhang & Jensen 1995).

A seta is lacking to the palpal femur and genu in the Allothrombiidae (Welbourn 1991; Zhang & Jensen 1995), as is the case in a number of the Microtrombidiinae (Southcott 1994)); other differences are listed above. The larval Trombidiinae lack only a palpal femorala.

If we accept in broad terms, the cladistic analysis of Welbourn (1991) for the larvae (the adult of *Yurebilla* being unknown), we may exclude it from the Tanaupodoidea on the ground of its lacking a lassenia organ (the only larval criterion given) and from the Chyzerioidea on the ground of its lacking elongate tarsi (again, the only larval criterion given). We must then decide whether to allot *Yurebilla* to the Trombiculoidea or the Trombidoidea, each in the sense of Welbourn (1991). According to Welbourn (1991: 164, 165) the only criterion separating these groups is the presence of "Apomorphy number 8" in the Trombiculoidea, i.e. the presence of seta 'theta on femur legs I, II &/or III'. This presumably refers to a solenoidal seta, on the analogy of setae omega, phi and sigma as used by the Grandjean school of setal terminology. This criterion is not understood, as I cannot find any evidence of such a seta in e.g. *Eutrombicula* or *Odontacarus*. Solenoidale (=spinalae) are present on the femora of larval *Nothrotrombidium*, family Trombellidae (Southcott 1987a), a family which Welbourn (1991) includes in his Trombiculoidea. We may therefore also exclude *Yurebilla* from the Trombiculoidea.

There appears little point in going through Welbourn's (1984) list of 41 characters in detail, as in 1991 he modified it by reducing the list to 19 characters of larvae and six of adults. In this all Trombidoidea were placed in four superfamilies. Accepting this revised classification, *Yurebilla* may be excluded from the Tanaupodoidea and Chyzerioidea (these separations could be supplemented with other characters), as well as from the Trombiculoidea.

Yurebilla clearly belongs to the Trombidoidea, even as used in the restricted sense of Welbourn

(1991), where it is divided into four families. In his earlier cladistic analysis Welbourn (1984) had given as major distinguishing characters 'Apomorphies 45 & 55' for the Trombidiinae and 'Apomorphy 24' for the Microtrombidiinae. Apomorphy 45 is the absence of a 'Distal eupathid (paraxial) on the tarsus of leg I', while the plesiomorphic state is its presence. In *Yurebilla* no such seta is present so that it comes within the 'Microtrombidiinae' of Welbourn (1984). Against this is the other criterion for Welbourn's (1984) 'Trombidiinae', of 'plesiomorphy number 24', i.e. four setae on genu II & III (the apomorphic state being of two setae). In 1991 Welbourn defined his 'Plesiomorphy 10' as being of more than four setae on genu II & III, and 'Apomorphy 10b' as of less than four setae for the Trombidoidea, neither of which applies in *Yurebilla*. Another criterion for Microtrombidiinae is 'Plesiomorphy 55', i.e. of one seta on coxa II, which applies in *Yurebilla* (also listed as 'Apomorphy 54' for the 'Podothrombiini'). In 1991, however, Welbourn included eight subfamilies in the Trombidoidea, including Trombidiinae, Allothrombiinae, Podothrombiinae, Microtrombidiinae and Eutrombidiinae.

One could go through the list of apomorphies and plesiomorphies given by Welbourn in his Figure 1 and Table 1 of 1984, finding characters possessed by *Yurebilla* in various subgroups of the 'Trombidiinae' and the 'Microtrombidiinae', but no set of characters which defines its position uniquely. Apart from the confusion in characters 54 & 55, it may be pointed out that Welbourn's Table 1 contains other errors, e.g. in characters 77 & 78, which disagree with each other, and characters 97-99, which repeat those of characters 49-51.

Despite *Yurebilla* (and Yurebillidae) not matching any of the criteria for family grouping in either of Welbourn's cladistic essays, I believe that it has most resemblances to the Allothrombiidae (Allothrombiinae), and regard it as nearest to that group.

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REFERENCES

- BERLESE, A. 1910. Brevi diagnosi de generi e specie nuovi di Acari. *Redia* 6(2): 346-388.
 BERLESE, A. 1912. Trombidiidac: prospetto dei generi e delle specie nuove finora noti. *Redia* 8(1): 1-291.
 ELLIS, R. W. 1976. The aboriginal inhabitants and their environment. Pp. 113-130 in 'Natural history of the Adelaide region'. Eds. C. R. Twidale, M. J. Tyler & B. P. Webb. Royal Society of South Australia:

- Adelaide.
- FEIDER, Z. 1959. New proposals on the classification of mites from the group Trombidia. *Zoologeskii Zhurnal* **38**(4): 537–549. (In Russian, English summary).
- FEIDER, Z. 1979. Principes et méthodes dans la taxonomie du groupe des Trombidia. Pp. 417–423 in 'Proceedings of the Fourth International Congress of Acarology, 1974'.
- HARRISON, J. L. 1954. A family of the great black scorpion (*Heterometrus longimanus*). *Malayan Nature Journal* **9**: 31–32.
- KRANTZ, G. W. 1978. 'A manual of acarology'. Second ed. Oregon State University Book Stores, Inc.: Corvallis, Oregon.
- LINDQUIST, E. E. & VERCAMMEN-GRANDJEAN, P. H. 1971. Revision of the chigger-like larvae of the genera *Neotrombidium* Leonardi and *Monunguis* Wharton, with a redefinition of the subfamily Neotrombidiinae Feider in the Trombidiidae (Acarina: Prostigmata). *Canadian Entomologist* **103**: 1557–1590.
- OUDEMANS, A. C. 1923. Studie over de sedert 1877 ontworpen systemen der Acari; nieuwe classificatie; phylogenetische beschouwingen. *Tijdschrift voor Entomologie* **66**: 49–85.
- ROBAUX, P. 1974. Recherches sur le développement et la biologie des acariens 'Thrombidiidae'. *Mémoires du Muséum National d'Histoire Naturelle. Nouvelle Série. Série A, Zoologie* **85**: 1–186.
- ROBAUX, P. 1977. Observations sur quelques Actinedida (=Prostigmata) du sol d'Amérique du Nord. VIII – Sur deux formes larvaires nouvelles de Trombidoidea (Acari). *Acarologia* **18**(4): 651–667.
- SHIBA, M. 1976. Taxonomic investigation on free living Prostigmata from the Malay Peninsula. *Nature and Life in Southeast Asia* **7**: 83–229.
- SOUTHCOTT, R. V. 1954. The genus *Neotrombidium* (Acarina: Leeuwenhoekidae). 1. Description of the ovum and larva of *Neotrombidium barringtonense* Hirst 1928, with an account of the biology of the genus. *Transactions of the Royal Society of South Australia* **77**: 89–97.
- SOUTHCOTT, R. V. 1982. Observations on *Chyzeria* Canestrini and some related genera (Acarina: Trombidoidea) with remarks on the classification of the superfamily and description of a pygmephorid mite phoretic on *Chyzeria*. *Records of the South Australian Museum* **18**(14): 285–326.
- SOUTHCOTT, R. V. 1986a. Australian larvae of the genus *Trombella* (Acarina: Trombidoidea). *Australian Journal of Zoology* **34**(4): 611–646.
- SOUTHCOTT, R. V. 1986b. Studies on the taxonomy and biology of the subfamily Trombidiinae (Acarina: Trombidiidae) with a critical revision of the genera. *Australian Journal of Zoology, Supplementary Series* No. **123**: 1–116.
- SOUTHCOTT, R. V. 1987a. The classification of the mite families Trombellidae and Johnstonianidae and related groups, with the description of a new larva (Acarina: Trombellidae: *Nothrotrombidium*) from North America. *Transactions of the Royal Society of South Australia* **111**(1): 25–42.
- SOUTHCOTT, R. V. 1987b. A new larval mite (Acarina: Trombidoidea) ectoparasitic on an Australian centipede, and the Trombidiidae reclassified. *Transactions of the Royal Society of South Australia* **111**(1): 43–52.
- SOUTHCOTT, R. V. 1992. Revision of the larvae of *Leptus* Latreille (Acarina: Erythraeidae) of Europe and North America, with descriptions of post-larval instars. *Zoological Journal of the Linnean Society* **105**(1): 1–153.
- SOUTHCOTT, R. V. 1993. Revision of the taxonomy of the larvae of the subfamily Eutrombidiinae (Acarina: Microtrombidiidae). *Invertebrate Taxonomy* **7**: 885–959.
- SOUTHCOTT, R. V. 1994. Revision of the larvae of the Microtrombidiinae (Acarina: Microtrombidiidae), with notes on life histories. *Zoologica (Stuttgart)* **144**: 1–155.
- THOR, S. 1935a. Übersicht und Einteilung der Familie Trombidiidae W. E. Leach 1814 in Unterfamilien. *Zoologischer Anzeiger* **109**(5–6): 107–112.
- THOR, S. 1935b. Änderung des Namens einer Unterfamilie der Trombidiidae W.E. Leach 1814. *Zoologischer Anzeiger* **110**(1–2): 47.
- THOR, S. & WILLMANN, C. 1947. Trombidiidae. *Das Tierreich* **71b**: xxix–xxxvi, 187–541.
- VERCAMMEN-GRANDJEAN, P. H. 1973. Sur les statuts de la famille des Trombidiidae Leach, 1815 (Acarina: Prostigmata). *Acarologia* **15**(1): 102–114.
- WELBOURN, W. C. 1984. Phylogenetic studies in Trombidoidea. Pp. 135–142 in 'Acarology VI', Volume 1. Eds. D.A. Griffiths & C.E. Bowman. Ellis Horwood Ltd: Chichester.
- WELBOURN, W. C. 1991. Phylogenetic studies of the terrestrial Parasitengona. Pp 163–170 in 'Modern Acarology', Volume 2. Eds F. Dusbábek & V. Bukva. Academia Prague, and SPB Academic Publishing by: The Hague.
- WOMERSLEY, H. 1954a. New genera and species, apparently of Apoloniinae (Acarina: Leeuwenhoekidae), from the Asiatic-Pacific region. 'Malaysian Parasites' (*Studies from the Institute for Medical Research, Federation of Malaya, No. 26*) VII: 108–119.
- WOMERSLEY, H. 1954b. On the subfamily Trombellinae Sig Thor 1935 (Acarina. Trombidiidae) with the diagnosis of the nymph of *Audyana thompsoni* Womersley, 1954. *Records of the South Australian Museum* **11**(2): 121–128.
- ZHANG, Z-Q. & JENSEN, A. 1995. The adult and larva of a new species of *Podothrombium* (Acari: Trombidiidae) associated with aphids in Oregon. *International Journal of Acarology* **21**(1): 3–9.